NOTES ON GEOLOGICAL SURVEYS.

THE VERMILION IRON-BEARING DISTRICT OF MINNESOTA.—This is the title of Monograph XLV of the United States Geological Survey, by J. Morgan Clements. It is in the usual quarto form, 466 pp., and is accompanied by an atlas.

This region is in the northeastern part of Minnesota, and embraces about 1,000 square miles. As nearly everywhere in the Lake Superior region, the rocks are of very great geological age. The relief is not great, and yet the country is rugged. The highest altitude is not much above 2,000 feet and the average relief approximates 500 feet. But owing to inequalities in structure and composition of the rocks, the surface is rough, marked by hills, great numbers of lakes, and swamps, or, as they are called by the Indians, *muskegs*, which represent formerly existing lakes, and now show conditions somewhat like the tundras of high latitudes.

Most of the drainage of the Vermilion District belongs to Hudson Bay, and is historically interesting as furnishing, in its strings of lakes, a convenient highway to the early fur traders of the Northwest. The lakes and streams trend northeast-southwest, and show thus the direction of the structural axis of the bed-rocks. The lake basins are interpreted as mainly due to preglacial valleys and glacial blockade. None were recognized as rock basins due to glacial excavation. The towns are few, and are all connected with the dominant industry. The body of the volume discusses the formation, the events of this most remote physical history, and the geological relations of the ores. The ores are chiefly hematite, and this alone is mined in the region. The ore bodies are lenticular in form and extend southwest-northeast, conforming in directions to the schists which inclose them. These deposits were first brought to public attention by J. G. Norwood in 1850, and again incidentally by a fruitless gold rush in the sixties. Actual development of these ores has extended over the past twenty-five years.

The relation of topography to geology is brought out in a brief chapter near the close of the monograph. Anticlines of older rocks, as a rule, form the ridges; while the valleys follow synclines of younger and softer rocks. Similar is the relation between the numerous salients and reëntrants found on the borders of the larger lakes. In some cases the forms of the lakes are plainly dependent on the direction of the jointing.

THE MESABI IRON-BEARING DISTRICT OF MINNESOTA.—This is the title of Monograph XLIII, in the same series with the last described, and the author is Mr. Charles Kenneth Leith. Monographs on the Marquette and other Superior districts have already appeared, and it is proposed later to issue a summary volume on the geology of the Lake Superior region as a whole.

The area treated by Mr. Leith has special interest for its great open-pit workings and as being the largest iron-producing group of mines in any land. This fact is the more startling when it is remembered that the first railroad and the first shipments date from the autumn of 1892. In that year 4,245 tons were shipped. In 1902 the total had risen to 13,329,953 tons.

The several chapters of the Monograph are devoted to history and literature of the field (II), the geology (III–VII), the iron-ore deposits (VIII), origin of the iron ores (IX), and mining, transportation, etc. (X). A short closing section treats of the methods and possible results of further exploration.

The ore bodies are of various sizes, ranging up to a quarter of a mile, not often more, in width, and with lengths of half a mile or more in many cases. The depth of the ore ranges from about 50 to 350 feet, though most deposits fall below 200 feet. The ores are mostly hematites, with a small percentage of combined water. Ore is seldom mined on the Mesabi range, which does not show 58 per cent. or above of iron. All the ore is bedded, and much of it is earthy in texture.

In mining, the glacial drift is first stripped off, averaging in depth from 20 to 40 feet. Railway tracks, of standard gauge, are carried to the deposit, and the ore is excavated with a steam shovel. As the excavated strip is widened, lower levels are opened up, until the pit becomes of enormous size, with a labyrinth of tracks, and with several ore trains, possibly, in process of loading at one time. Underground methods are used, but to a minor degree, and in special cases, to avoid heavy stripping, the construction of graded approaches, or the interruptions of climate. The delivery of the ore at the Lake Superior docks and its water transportation to points of consumption are well known.

Exploration of new territory is carried on by test pitting, or by churn or diamond drilling. Two hundred drills are said to have been continuously in use in the Mesabi district in the previous year.

GEOLOGY AND WATER RESOURCES OF THE SNAKE RIVER PLAINS OF IDAHO; ISRAEL C. RUSSELL, BULLETIN 199, U. S. GEOLOGICAL

SURVEY; ALSO, GEOLOGY OF SOUTHWESTERN IDAHO, AND SOUTHWESTERN OREGON, SAME AUTHOR; BULLETIN 217.—These papers possess much geographic interest, from their abundant and vivid descriptions of climate, topography, and resources, but are here cited more particularly for their contributions to our knowledge of volcanic operations in the Cordilleran region. The Snake River lavas form a plain about 20,000 square miles in extent, stretching in a crescent from near the western border of the Yellowstone Park to Boise. The concave border of this curved belt is toward the north, and the river is near its southern boundary. A curious consequence is that perennial streams, with small exception, do not reach the river from the lofty mountains on the north, the waters being swallowed up in the cells and fissures of the lava, and issuing in a remarkable series of strong springs along the north walls of the Snake River Cañon. In particular, at the Thousand Springs, innumerable torrents spring from the cañon walls and break into foam as they fall. These springs and the various falls along the river make an enormous resource of power for Southern Idaho.

From the scientific point of view, the most interesting conclusion of the author is that these lavas are not, in accordance with the general view, the product of fissure eruptions, but rather the result of the effusions, at many vents, of very liquid lavas. Scores of such points of outflow were recognized, and others were safely inferred to lie beneath coverings of later lava. Thus broad and very flat cones were formed, often not more than 200 or 300 feet high, but 8 or 10 miles in diameter at the base, and merging so gradually with neighbouring flows that often the eye cannot pick out the line of demarkation. The slope for the flow of the lavas had often to be produced by the thickening of the lava sheet around the orifice. The lavas often enter deep embayments in the mountains north or south. In some cases the streams actually poured into these valleys from vents on the plains, like the tide entering gulfs on the sea border; while in other cases the lavas proceeded from vents in the uplands and flowed down the valleys like rivers entering the ocean. For these results remarkable fluidity of the lavas was requisite, and flows were traced, in some cases, for 50 miles.

The reader is referred to the two reports for the many details of volcanic work and volcanic formations, here seen as vividly as in the study of modern Hawaii or Vesuvius. Among these are the cinder buttes, the breached cones, the crags of tuff carried out and still resting on lava flows, and the great variety of volcanic bombs

and lava splashes, showing conditions of fusion, manner, or extent of aerial transit, etc. All these features are well illustrated with photographs, and the bulletins could be read with great profit by students and teachers of geology and geography.

A. P. B.

THE NEW SEAPORT OF ZEEBRUGGE, BELGIUM.

In mediæval times the City of Bruges ranked among the most flourishing of European ports. At that period Bruges held direct communication with the North Sea by means of an estuary; but gradually this was filled up with sand, and the old Hanseatic town fell from its high estate.

At the present day vast maritime undertakings are being developed, with the two-fold object of reviving the commercial prosperity of Bruges and of founding a port of call for the whole country. The new town has been christened Zee Brugge (Bruges-on-Sea).

For a port of call the Belgian coast is advantageously placed, as its situation is such that it can admirably knit together both land and sea going traffic without loss of time, uniting security with rapidity to such a degree that the mechanism of transit is perfected. On the one side a continuous current of merchandise passes within sight of the Belgian coast, conveyed by the great German shipping lines from Hamburg and Bremen, and on the other a radiation of railways stretches towards Paris, Berlin, St. Petersburg, Vienna, Constantinople, and Italy. These two great trade lines, converging on Zeebrugge, will be of mutual assistance, and will enormously facilitate the inflow of produce all over Europe.

The works in progress consist of three parts: the actual port of call at Zeebrugge, the canal uniting Bruges and the sea, and, lastly, the local installations at Bruges.

As the plan shows, the chief feature of the port of call is an immense breakwater or pier which runs out from the land, curves to the east, and finally stretches parallel to the coast 1,200 yards from low-water mark.

This breakwater encloses and protects against the prevailing south and northwest winds a harbour 420 acres in extent.

The breakwater consists of three parts. From the shore runs